Jefferson Lab's 2006 Site Environmental Report

Aerial view of the Continuous Electron Beam Accelerator Facility at Jefferson Lab

Thomas Jefferson National Accelerator Facility (Jefferson Lab) is managed by Jefferson Science Associates, LLC for the U.S. Department of Energy Office of Science
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The Thomas Jefferson National Accelerator Facility
SITE ENVIRONMENTAL REPORT
For Calendar Year 2006

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TJNAF'S SITE ENVIRONMENTAL REPORT
FOR CALENDAR YEAR 2006

EXECUTIVE SUMMARY

This annual report documents the Thomas Jefferson National Accelerator Facility (TJNAF) active environmental protection program by presenting the results of environmental activities and monitoring programs that are within the Lab's EMS (environment management system). The report provides the U.S. Department of Energy (DOE) and the public with information on radioactive and non-radioactive pollutants, if any, added to the environment as a result of Lab operations.

The Lab continued to be operated by the Southeastern Universities Research Association, Inc. (SURA) during the first portion of 2006. On June 1, Jefferson Science Associates, LLC (JSA) replaced SURA as the management and operations contractor. JSA is a joint venture of SURA and Computer Science Corporation.

Major Scientific and Research Programs

TJNAF's main purpose is to make available a research facility to support the nuclear physics community and the nation.

CEBAF The Continuous Electron Beam Accelerator Facility (CEBAF) at TJNAF provides an electron beam to three experimental halls where a variety of basic physics experiments are conducted. The electron beam begins its first orbit at the injector and proceeds through the underground racetrack-shaped accelerator tunnel at nearly the speed of light. The accelerator uses superconducting radio frequency (SRF) technology to drive electrons to higher and higher energies. The accelerator's electron beam can be split for simultaneous use by the three experimental halls, which are circular, partially buried domed chambers. Special equipment in each hall records the interactions between incoming electrons and the target materials. A continuous electron beam is necessary to accumulate data at an efficient rate yet ensures that each interaction is separate enough to be fully observed.

Initial authorization to upgrade the accelerator to 12GeV (gigaelectron Volts) from the current 6 GeV was provided by the DOE in 2006.

FEL The Free-Electron Laser supports basic science research and serves universities, private industry, NASA (the National Aeronautics and Space Administration), the U.S. Navy, the U.S. Air Force, and the U.S. Army. Designed and built with TJNAF's expertise in SRF accelerator technology, the FEL provides intense, powerful beams of laser light that can be tuned to a precise wavelength or color. The FEL is the most powerful tunable laser in the world, and has produced well beyond its design level of 10 kilowatts (kW) average power. It attained a record 14.2 kW at a wavelength of 1.61 microns on October 30, 2006, an important wavelength for both the optimal transmission of laser light through the atmosphere and for materials processing. The FEL also holds the world record in generating terahertz wavelengths.

Research Areas Staff and visiting scientists will continue using TJNAF's Center for Advanced Studies of Accelerators (CASA), the SRF, and the Lattice Quantum Chromodynamics (LQCD) Computing Project, to perform research and development (R&D) programs to lead the world in both SRF and energy-recovering linac technologies. This research will also involve providing these technologies and the supporting knowledge base for the construction of new accelerators for DOE

Office of Science research projects at other laboratories in nuclear physics, basic energy sciences, and possibly high energy physics.

The E in Environment, Safety, and Health (ES&H)

Ultimate responsibility for protection of the environment and public health rests with the Lab Director, while line management implements identified objectives within their areas of responsibility. ES&H staff, situated within both the line organizations and in the Environmental, Safety, Health, and Quality (ESH&Q) Division, provide support to line management and share their expertise with the Lab as a whole. TJNAF's program is implemented in numerous ways.

Integrated Safety Management (ISM) System Through ISM, TJNAF incorporates ES&H requirements into all work procedures. The primary objective of ISM is to make safety, health, and environmental protection a part of routine business at TJNAF. During 2006, the Safety, Health & Environmental Protection Policy was updated to better incorporate ISM principles. As well, with the new contract and organization change, a transition to evaluate and incorporate all new contractual requirements started with the inception of JSA.

Environmental Management System (EMS) Implementation Since its inception, TJNAF has had an environmental protection program. The Lab's EMS was declared established by the Department of Energy in December 2005. Throughout 2006, involved Lab staff, including the EMS Committee, continued to integrate EMS elements into Lab programs and procedures.

Work Smart Standards (WSS) Process The goal of the WSS process is to provide a means to implement EH&S in a manner that is both effective and cost-efficient. The WSS Set is comprised of the laws, regulations, and standards necessary and sufficient to ensure worker and public health and safety, and to protect the environment.

Implementation of the National Environmental Policy Act (NEPA) Most facility construction activities and all accelerator upgrades are subject to review under the NEPA. The initial TJNAF construction, a later upgrade to CEBAF, and some major new buildings have been addressed in Environmental Assessments (EAs). An EA published in January 2007 addressed both the planned 12 GeV CEBAF upgrade and other activities identified in the Lab's Ten-Year Master Plan. Routine Lab activities and special projects are usually covered under site-specific NEPA Categorical Exclusions (CXs).

ESH&Q Performance Measures Both the DOE/SURA and DOE/JSA contract-based measures are used to evaluate TJNAF's ES&H performance. The fiscal year 2006 measures include items such as permit exceedances and affirmative procurement performance. The Lab reached its affirmative procurement goal of 100% for fiscal year (FY) 2006. Also addressed in both contracts are metrics involving worker safety and health. The Lab received an excellent FY 2006 "A-" rating in ES&H; environmental performance, though still very good, received a "B" rating.

Inspections TJNAF's commitment to protection of the environment and public health and safety are demonstrated through its inspection programs. Both key Lab staff and external agencies, including the local sanitation district, and DOE Site Office staff, conduct inspections to ensure operations and activities at TJNAF are being done in the most sound manner. The Environmental Protection Agency (EPA) performed an unannounced multimedia inspection in June 2006. Such inspection results, along with compliance with all applicable laws and regulations, are provided in this report.

Compliance

Except for one minor incident, a low pH reading in our sanitary sewer waste water stream in September, TJNAF complied with all applicable Federal, State, and local environmental laws, regulations, and DOE guidance during 2006. As a result, TJNAF operations had no discernable impact on public health or the environment. A June 2006 EPA multimedia compliance inspection noted only a few minor concerns, which were addressed immediately. The Lab was therefore found by the EPA to be in compliance with all reviewed regulations. Individual programs reviewed by the EPA are discussed herein.

The Lab compliance status within all environmental programs is discussed in Section 2 of this report. Radiation-related issues, especially those dealing with water resources and public health, are highlighted in Section 3. Non-radiological environmental issues, such as water sampling and monitoring, are addressed throughout this report. The TJNAF ES&H Manual, which addresses many environmental topics, and the Lab's WSS Set are regularly updated to ensure that new environmental compliance initiatives are integrated into site operations.

Special Item – Pollution Prevention Awards
Cryogenic Refrigeration System Improvements at Jefferson Lab

An innovative helium refrigeration process which substantially reduces the amount of electricity and cooling water required (by as much as 35 to 45 percent), was developed and demonstrated. At TJNAF, costs of approximately $1,000 per day can be avoided by fully integrating this process. This innovation was granted both a DOE Best in Class award for FY 2006 and a 2007 White House Closing the Circle award. The process is already being put into practice both at other DOE facilities and in general industry.

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INTRODUCTION

1.1 PURPOSE OF THIS REPORT

The U.S. Department of Energy (DOE) requires its facilities to establish and annually report on environmental programs and performance. This document marks the 13th year that Thomas Jefferson National Accelerator Facility (TJNAF) has been preparing a Site Environmental Report (SER). This report addresses the status and results of the Lab's environmental protection (EP) program, which also addresses public health items, for calendar year (CY) 2006. It serves to inform TJNAF staff, DOE, regulators, and the public about site environmental performance, and provides a historical record of identified items of interest or concern.

The SER is available in a viewable downloadable pdf file. The CY 2006 SER, along with the earlier reports, can be found at by going to TJNAF's web page at http://www.jlab.org/ehs/ser/.

1.2 LABORATORY MISSION

TJNAF is a national accelerator facility managed and operated over the course of 2006 by both the Southeastern Universities Research Association. Inc. (SURA) and Jefferson Science Associates, LLC (JSA) for the DOE. The accelerator complex portion of the Lab includes an underground electron accelerator, the Continuous Electron Beam Accelerator Facility (CEBAF), which is TJNAF's primary research tool. CEBAF operates at energies up to about 6 GeV (billion (Giga-) electron volts) and provides beam to three underground halls that house physics program experiments. The CEBAF accelerator is used to conduct physics user driven research into how nucleons are built from quarks and gluons, and how this structure leads to the standard nucleon-based picture of the nucleus.

TJNAF's basic mission is to provide forefront scientific facilities, opportunities, and leadership essential for discovering the fundamental nature of nuclear matter, to partner with industry to apply its advanced technology, and to serve the nation and its communities through education and public outreach, all with uncompromising excellence in environment, safety, and health.

1.3 SITE OPERATIONS

As a world-class research institution, TJNAF attracts resident and visiting physicists and other scientists. Approximately 630 full-time physicists, engineers, technicians, and support staff work at the Lab. More than 1,200 academic and industrial researchers from across the United States and from approximately 30 countries and 187 institutions participate in scientific collaborations at TJNAF. Since TJNAF first began running experiments with CEBAF in 1994, data have been gathered for 131 experiments, and partial data have been gathered on another ten experiments. On average, TJNAF research has been the basis for the theses of 25-30 percent of all new U.S. nuclear physics Ph.D.s each year for the last several years. The Lab has thus far produced more than 220 patent disclosures. Of those, 140 were submitted for the patent-application process. Seventy patents had been issued by the end of 2006, including light-guide technologies, medical imagers, flaw-detection equipment, a fire detection/prevention system, and an electronic lockout device that can be used for both safety and security purposes.

There are six major facilities and program areas on the DOE site:

- CEBAF, a superconducting radio frequency (SRF) electron accelerator;
- End Stations A, B, and C (large halls that house physics experiments), which make use of beams from CEBAF;
- the Institute for SRF Science and Technology, which serves primarily as an R&D center for SRF accelerator cavities;
- the Center for Advanced Studies of Accelerators (CASA), which supports the site accelerators and considers future planning opportunities;
- a Free-Electron Laser (FEL) User Facility, which produces laser beams to serve university, industry, and military partners; and
- a Lattice Quantum Chromodynamics (LQCD) Computer, a 1/4 Teraflop commodity-PC-based machine.

The site buildings and end stations can be seen on Figure 1.3-1, a site map of Jefferson Lab.

1.4 SITE HISTORY AND DESCRIPTION

Prior to the construction of TJNAF, there were several occupants of this general area of Newport News. The U.S. Department of Defense (DOD) acquired most of the Oyster Point area, including the land presently used by TJNAF. The U.S. Air Force later acquired the land and installed a BOMARC missile site on a portion of the property. After closure of the BOMARC missile base, the DOD started disposing of the property and conveyed some land to the Commonwealth of Virginia, the National Aeronautics and Space Administration (NASA), and others. Ownership of the NASA property, including 100 acres of undeveloped land, was conveyed to the DOE in 1987. An additional 52 acres of land was also transferred to the DOE from other sources. The total DOE-owned parcel upon which TJNAF is built is 163 acres.

In 1986, an adjacent 44 acres were conveyed to SURA by the City of Newport News. A SURA residence facility is located on a portion of this land. Adjacent to this property is the former BOMARC missile site.

Sign at Main Entrance to TJNAF

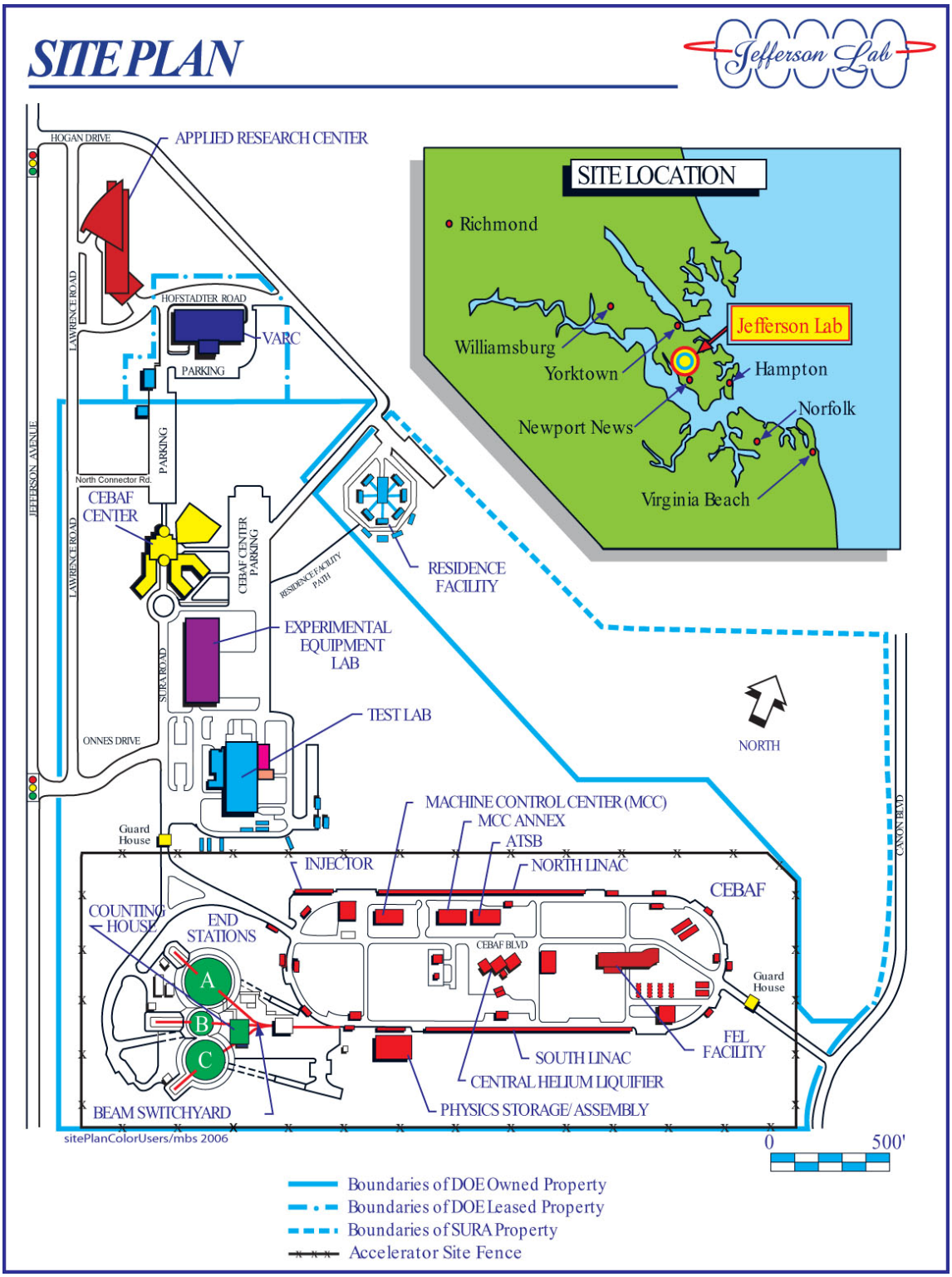


Figure 1.3 - 1
Site Map

Also adjacent to the DOE-owned site is a 10.7-acre parcel owned by the Commonwealth of Virginia and leased to the City of Newport News. The Applied Research Center (ARC) is located on this property, and is used by TJNAF, industry, and universities. Other adjacent land owned by the Commonwealth of Virginia is leased to JSA and the DOE for its use in support of Lab operations. This area, the DOE-owned site, and other nearby properties are considered part of the city's Jefferson Center for Research and Technology.

1.5 FACILITIES AND 2006 ACTIVITIES

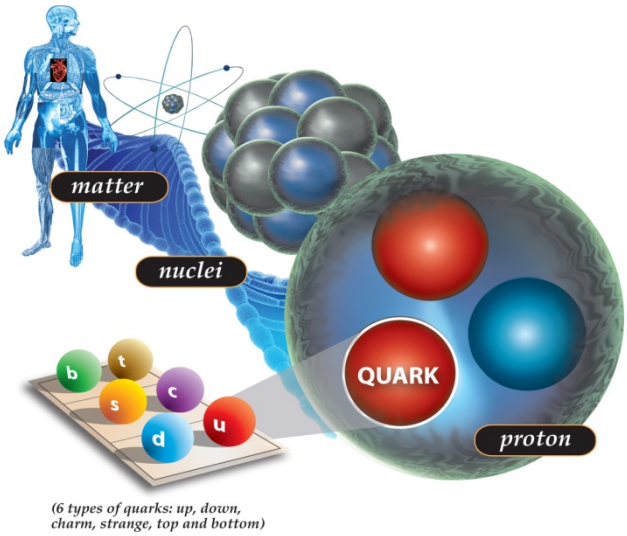
The 163-acre DOE site is primarily divided into two main areas. One includes R&D labs, fabrication facilities, and administrative offices and is referred to as the campus. The second is a 40-acre fenced area, termed the Accelerator Site, where the CEBAF and FEL accelerators and related structures that accommodate experiment support functions are located. The accelerator site is located on the south end of the DOE property, and access is restricted through one entrance that is staffed 24 hours a day. The front view of the main administration building, CEBAF Center, located on the campus, is shown in the photo following this text.

Front Entrance to CEBAF Center

Facilities

There are four major facilities that have more than minimal environmental protection or public health-related implications. They are CEBAF, its experimental halls (End Stations), the SRF Facility, and the FEL User Facility. A short description of each follows. These facilities and other activities that have potential environmental implications, such as the use of chemicals and oil products, are discussed elsewhere in the report.

CEBAF This accelerator provides continuous wave electron beams with energies of 0.5 to 5.7 GeV. CEBAF is used as a tool for exploring the transition area or range where strongly interacting (nuclear) matter can be understood as bound states of protons and neutrons, and the regime where the underlying fundamental quark-and-gluon structure of matter is evident. The nature of this transition is at the frontier of our understanding of matter.



Atomic Structure

End Stations (Halls A, B, and C) Each hall (or end station) has its own set of complementary experimental equipment. Hall A has a pair of superconducting, high-resolution magnetic spectrometers optimized for precision electron scattering coincidence experiments. The CEBAF Large Acceptance Spectrometer (CLAS), which supports studies of both electron- and photon-induced reactions, is housed in Hall B. The third end station, Hall C, contains a pair of moderate resolution spectrometers, with one capable of high momentum particle detection, and the second optimized for the detection of short-lived reaction products.

The SRF Facility The SRF program is centered in the Lab's Institute for SRF Science and Technology. This Institute's strength is in R&D and large-scale applications of SRF, including to better upgrade or advance CEBAF and the FEL. Some ongoing work in the ARC also supports development of state-of-the-art surface science and SRF R&D to improve accelerator capabilities.

FEL User Facility The FEL is an accelerator that was initially designed to provide 1,000 watts (1 kilowatt (kW)) of infrared (IR) light with picosecond pulse length for use by TJNAF, industrial, DOD, and university partners. The accelerator has since been upgraded, enabling operation in a range that extends from 1,000 watts of ultraviolet (UV) light to 10,000 watts (10 kW) of IR light.

Achievements and Future Planning

The FEL is an unparalleled laser in its capability as a light source, and is opening up new applications in national security, materials science, photobiology, photochemistry, and high sensitivity spectroscopy. These applications hold such exciting research potential that the TJNAF FEL is being replicated at a number of institutions.

Analysis and R&D work on the proposed upgrade of CEBAF to 12 GeV continued in 2006. This upgrade in electron beam energy levels, new or upgraded equipment in the three existing experimental halls, and a future experimental hall, Hall D, will support experiments that test the strong force that holds atomic particles together.

ENVIRONMENT, SAFETY, AND HEALTH

Environmental Review

An environmental assessment, termed EA, performed under National Environmental Policy Act (NEPA) procedures, was conducted prior to the construction of the original CEBAF project, resulting in a Finding of No Significant Impact (FONSI). In 1997 and 2002, EAs that also yielded FONSIs addressed a CEBAF upgrade, an FEL upgrade, and five building construction projects. Existing NEPA-related documentation is periodically reviewed. In April of 2005, an Environmental Assessment Determination Proposal for the further upgrade and operation of the CEBAF and FEL accelerators and construction and use of buildings associated with the TJNAF's 2005 Ten-Year Site Plan was recommended. In 2006, DOE/EA-1534 was prepared to assess the impacts of the proposed actions, including the 12 GeV CEBAF upgrade. This EA also resulted in a FONSI issued in January 2007, documenting that an Environmental Impact Statement was not required for the defined action.

ES&H Resources

To ensure that staff, employees, subcontractors, and users are aware of and utilize ES&H principles, ES&H responsibilities are incorporated into each position description. The facility makes available to every employee, user, and visitor, a variety of ES&H resources to serve the TJNAF community. Local resources include: 1) ES&H staff that support specific line organizations; 2) ES&H program specialists that serve the entire facility in their area of expertise; 3) groups and committees that address Lab-wide concerns, develop policy, and resolve selected issues; and, 4) the TJNAF ES&H Manual, the primary source of ES&H implementing procedures. Other ES&H resources available to and utilized by program managers include: DOE subject matter experts; DOE program specialists who deal with policy issues at all levels; and colleagues at other DOE facilities who share expertise and lessons learned from their own unique experiences.

SECTION 2
ENVIRONMENTAL PROTECTION PROGRAM

There are many facets to TJNAF's Environmental Protection (EP) program. As stated in Section 1, the Lab's mission, along with worker health and safety, includes protection of the environment and public health. Various controls, including the Lab's Integrated Safety Management (ISM) System and the Environmental Management System (EMS), were used in 2006 to accomplish the EP aspect of the mission.

The site's EP program provides guidance and requirements for implementing site environmental programs, for making environmentally preferable choices, and for the review of performance through assessments and inspections. TJNAF had one mishap in September 2006 resulting in a notice of violation from the local sanitary wastewater district. The cause was identified promptly and remedied. Compliance with both applicable EP and public health-related laws and regulations are interwoven into Lab operations. Other than the above-mentioned incident, TJNAF demonstrated compliance with these laws and regulations. There were no compliance findings noted at the closing session of the June 2006 EPA multimedia inspection. TJNAF's EMS program was identified by the EPA's lead inspector as a model program. Areas reviewed during the inspection included water, air, waste, and emergency planning and reporting. EPA's concerns regarding some regulatory interpretation issues are noted in the waste program section below (Section 2.2.2.3).

2.1 ENVIRONMENTAL MANAGEMENT SYSTEM

An EMS focuses on establishing management-level programs that serve as the basis to direct the performance of Lab activities that could affect the environment. The overall management system format includes setting up the organizational structure, planning activities, responsibilities, procedures, processes, and resources for developing, integrating, achieving, reviewing, and maintaining the commitments made in the Lab's Safety, Health and Environmental Protection Policy.

The DOE declared that the Lab's EMS was in place in December 2005. The EMS serves in conjunction with the Lab's already-established ISM System. The objective of these systems is to make safety, health, and environmental protection a routine part of doing business at and with TJNAF. The EMS is based on International Organization of Standardization (ISO) 14001 and DOE Order 450.1, *Environmental Protection Program*. In 2006, elements of the EMS continued to be incorporated into existing site documents, such as the Lab's ES&H Manual and workplace standard operating procedures (SOPs).

Site Policy on Safety, Heath and Environmental Protection
TJNAF's Policy includes EMS and was updated in July 2006 to further incorporate ISM principles. The updated policy reflects the current ES&H commitments to both the Lab population of staff, users, and visitors, and to our local community neighbors.

A portion of TJNAF's Safety, Health, and Environmental Protection Policy follows:

> "Jefferson Lab considers no activity to be so urgent or important that we will compromise our standards for environmental protection, safety, or health. It is Jefferson Lab's policy to identify and meet all applicable ES&H laws, regulations, standards, and our contractual commitments to the Department of Energy…"
>
> Christoph Leemann, TJNAF Director
> July 2006

Environmental Planning and Analysis Procedures
Environmental planning and analysis are accomplished by documenting and reviewing projects and activities for EMS considerations, such as through NEPA. Line management is responsible for providing notification of actions and impacts of new activities to the ESH&Q Division's environmental staff for review and authorization as applicable. TJNAF flows down appropriate ES&H requirements, through subcontract documents, to its subcontractors. These documents address environmental consequences and identify mitigation measures to minimize any such consequences.

Environmental Objectives and Targets
The Lab operates within the DOE/JSA contractual requirements, including meeting all environmental conditions noted in permits. Also, as TJNAF implements its EMS, it regularly identifies environmental objectives and targets that would improve site programs, including those that would increase the Lab's focus on the pollution prevention (P2) process.

Implementation and Operations Controls
The DOE/JSA contract and environmental permits define the environmental protection terms and conditions for the operation and performance of TJNAF. ISM (including environmental protection) roles, responsibilities, and implementation procedures are included in the Lab's ES&H Manual. EMS awareness training for Lab staff continued in 2006. Lab management committed to and developed programs to provide EMS awareness training to subcontractors and visiting scientific users during 2006.

The Lab develops Target Implementation Plans (TIPs) under its EMS. Lead is used extensively for radiological shielding in the accelerator tunnel and in the experimental halls. One TIP to improve lead storage practices facilitated the design for a lead storage facility. In 2006, the lead storage facility was constructed and began functioning. At the time that collection of lead began in the new facility, the Lab temporarily became a self-declared large quantity generator (LQG) of hazardous waste. This occurred in June 2006, then TJNAF returned to small quantity generator (SQG) status (which was documented in a letter from the Virginia Department of Environmental Quality (DEQ) in August.

Identification of Environmental Aspects and Impacts
Updates to the EMS-specific aspect and impact identification were made in 2006. The primary environmental aspects at TJNAF continued to be water discharges and waste issues. In addition, intensive uses of resources such as electricity and water that are needed to operate a particle accelerator are considered aspects.

Performance Measurement
The Lab, on a quarterly basis, reviews contract performance measure results for various topical areas that include ES&H. Meeting measurable objectives in the form of best management practices (BMPs) including those that exist within the general site storm water permit, were reviewed in 2006. The Lab's BMPs under that permit were updated for use in 2007 to better reflect current site storm water management measures. The Lab, with assistance from the DOE, continued to monitor EMS implementation progress via an internal September 2006 EMS audit.

Corrective Action and Self-Assessment Procedures

In 2006 the Lab successfully completed all corrective action items identified from the December 2005 EMS improvement initiative. An EMS management audit/assessment was conducted in September 2006.

A consultant and a DOE Oak Ridge specialist served as the primary audit team. No compliance violations were noted; however, 16 opportunities for improvement were identified. Each of the improvement opportunities was assigned to an appropriate staff member and recorded in the site's corrective action database. In addition, as part of their June inspection, the EPA inspection team reviewed the Lab's EMS program and complimented the Lab on its program.

Management Review Process
The Director's Council, comprised of senior management, reviews the ISM System Program Description through regular reviews. The Lab also has an EMS management review procedure. The EMS Management Representative and other senior managers reviewed the Lab's EMS program along with the 2006 internal EMS audit/assessment.

2.2 MAJOR ENVIRONMENTAL PROTECTION PROGRAMS

2.2.1 Environmental Monitoring Program

Environmental monitoring is one of the primary methods the Lab uses to assess environmental conditions. Monitoring is conducted to: verify compliance with applicable regulations and other requirements; evaluate the Lab's impact on the environment and public health; identify potential environmental problems; provide data to support management decisions; and evaluate the need for remedial actions or mitigative measures.

The site program establishes guidelines for examining potentially environmentally harmful materials such as chemicals, oils, and radioactive materials that are generated by the facility. An integral part of the program is routine sampling and tracking of air emissions, process water, wastewater, and groundwater. These are monitored to ensure that environmental releases from TJNAF do not have a negative impact on the surrounding environment and that they remain within any applicable permit or other regulatory requirement.

Both permit-required and routine monitoring practices center on the potential environmental exposure pathways appropriate to medium-energy particle physics laboratories. These pathways include personnel exposure to external and internal radiation, a major focus of the site's monitoring program. Programs responsive to on-site and offsite radiation protection requirements have been instituted. Exposure potentials for radiation are discussed in Section 3.

Standard sample collection and analysis methods are documented in program and departmental procedures. Routine environmental monitoring is performed under the direction of responsible line management and is overseen by the Lab's ESH&Q Division's environmental staff. General program information is provided below.

2.2.1.1 Monitoring Water Conditions

Both ground and surface water quality protection are high priorities at TJNAF. Groundwater quality is a focus area primarily due to operating the underground CEBAF accelerator and the potential for groundwater activation. Preventing surface water pollution is another area of attention during both general site usage and civil construction actions.

Rain Garden at TJNAF

Standards used to protect water quality include Virginia regulations, the Clean Water Act (CWA), and others identified in the Lab's WSS Set. TJNAF complies with all requirements and performs monitoring under some of the applicable site water quality permits. The Lab held a maximum of six active water permits in 2006, discussed further below: one for groundwater quality, one general permit for cooling water discharges, two for surface storm water quality, one for groundwater dewatering, and one for industrial sanitary wastewater discharges. By the end of 2006, the cooling water general permit was merged into the Lab's individual groundwater quality permit. In addition, the authority for the two surface storm water-related permits was transferred from one Commonwealth agency to another.

Groundwater quality is maintained through managing operations and implementing shielding to minimize impacts. Surface water quality is maintained by discharging to the environment only permitted effluent from cooling towers and unpolluted waters, such as rainwater. Control measures identified for the site include using Lab programs and procedures where materials of concern are used or stored. Other than the Hampton Roads Sanitation District (HRSD) notice of violation and the temporary change to LQG status, all environmental permit conditions were met in 2006. Other site water quality programs that do not involve monitoring also apply and are described in Section 2.2.2.1.

The multimedia compliance inspection by the U. S. EPA was conducted on June 26-28, 2006. The Lab's programs under all water permits were reviewed during this inspection. The reviewers did point out that one storm water channel that flows under the accelerator site fence had debris and soil was eroding along the side of the storm water channel. This erosion concern was already being addressed, and was remedied soon after the inspection was

completed. Except for that one concern, there were no water-related deficiencies or recommendations noted in the EPA inspection close out presentation.

Information on general water quality parameters is included in the rest of Section 2.2, and radiological parameter information is presented in Section 3.2.

Virginia Pollutant Discharge Elimination System (VPDES) Permits

Facilities in Virginia that directly discharge to waters of the United States must obtain a VPDES Permit, which satisfies Federal National Pollutant Discharge Elimination System requirements. The Virginia program is designed to protect surface waters by limiting primarily non-radiological releases of effluents into streams, lakes, and other waters, including wetlands. TJNAF began 2006 with two VPDES permits: one for cooling tower discharges, and one for site storm water runoff. Quarterly reports under these two permits are provided to the Virginia DEQ.

Cooling Water Discharges – VPDES General Permit No. VAG250018 and VA0089320

This discharge is the effluent from the CHL Building (Building 8) cooling towers. It was covered under the general permit (VAG250018) until superseded by VPDES Permit No. VA0089320 in July 2006.

Both the permits for this discharge covered the same water quality parameters; however, the reporting limits changed under the new permit. The major change set a very low chlorine limit of 0.019 mg/l (milligrams/liter), a level at which there are no acceptable sampling and quality assurance techniques. According to the DEQ, the lowest quantification level recognized by the DEQ, 0.1 mg/l, remains satisfactory for reporting and meeting permit terms.

Quarterly sampling was performed and flow information as well as sampling results for pH, temperature, ammonia, total hardness, total dissolved copper, total dissolved zinc, and total residual chlorine were reported under the terms of the applicable permit. The products that TJNAF uses for cooling water treatment were approved by the DEQ and there are no environmental concerns with the use of these water treatment products.

Groundwater Monitoring - VPDES Permit No. VA0089320

This individual permit covers the quality of groundwater flowing across the site, including groundwater that is discharged to the surface in a dewatering operation to prevent damage to the experiment apparatus in the partially buried experimental halls. The new permit, effective July 17, 2006, incorporated the discharges from the cooling towers, as noted above.

Wells and Dewatering

Groundwater monitoring for both non-radiological and radiological quality is conducted and results are reported for fifteen monitoring wells and at the groundwater dewatering collection point. Reports for each well are provided on an either quarterly, semi-annual, or annual basis. The wells and the collected withdrawn groundwater were sampled for the general water quality parameters of pH,

conductivity, total suspended solids (TSS), and total dissolved solids (TDS). Monitoring for radioactivity is discussed in Section 3.

Because of the potential for activation of groundwater from accelerator operations, baseline water quality values for certain parameters were obtained prior to 1995, and their collection completed when the accelerator became operational. The present well monitoring program enables the comparison of current and baseline values to verify that TJNAF site activities are not degrading the quality of local groundwater. Non-radiological and radiological sampling data collected in 2006 were representative of groundwater quality during accelerator operations and are consistent with previous baseline measurements.

Cooling Water Discharges (4th quarter 2006)

The parameters reported herein were the same as those reported under the previous permit, with the exception of the chlorine limit, as discussed above. There were no concerns noted under this permit in 2006.

Hampton Roads Sanitation District Permit No. 0117

Facilities in Virginia that discharge to the Hampton Roads Sanitation District (HRSD) must obtain this industrial wastewater discharge permit. The HRSD program is designed to meet all Virginia effluent limits. Standard industrial wastewater, cooling tower effluent for all but the building 8 tower mentioned earlier, and a small quantity of activated water are authorized for release per permit conditions.

HRSD conducted an inspection on February 6, 2006. The inspection covered several TJNAF buildings and a review of monthly and quarterly records. There were no identified concerns that required any response to HRSD. TJNAF received a Gold pretreatment excellence award for its 2005 performance, and would have received the same in 2006 were it not for the one September pH violation. Our otherwise excellent performance still qualified us for the Silver Pretreatment Excellence Award for 2006.

To meet monitoring requirements, TJNAF performs monthly sampling at two sanitary sewer outflow streams to verify that pH levels are within permit limits. Besides the discharges noted above, there are three special discharges to the sanitary sewer system. TJNAF has three elementary neutralization systems that record pH information electronically and have built in safeguards to prevent release of any acid below a set pH value. The primary system in Building 31 handles waste acid from cryomodule research and development, cavity production, and some general maintenance activities. A small elementary neutralization tank in Building 31 handles waste acid rinsewater, and a third system handles small amounts of rinsewater from a small chemistry lab in Building 58.

The activated water that was collected and discharged in 2006 was a combination of the output from dehumidification equipment in the experimental halls and small withdrawals from various beam dump cooling water systems. The activated water program is appropriately managed by the Radiation Control (RadCon) Department to stay within all permit requirements. The total radioactivity discharged to the sanitary sewer in 2006 was 0.943 Curie (Ci) of tritium (or about 19% of the 5 Curie total allowed under the permit), and 0.0014 Ci of other gamma-emitting radionuclides (or 0.14% of the total 1 Curie allowed under the same permit).

For all monitoring, subcontracted analytical laboratories, and/or RadCon Department staff (for radiological parameters only), perform all sampling at the prescribed sampling points. HRSD independently performs periodic sampling at all discharge streams for a full complement of metals and other parameters to validate TJNAF's compliance with permit and regulatory requirements. This includes an annual seven-day period of monitoring flows and taking samples to help determine if our discharges remain consistent and if any changes to the permit are necessary. On September 27, TJNAF received a notice of violation for going below the Lab's HRSD pH permit limit of 5.0. This incident occurred during the above-mentioned annual week-long manhole sampling performed by HRSD. The cause was identified promptly and remedied.

2.2.1.2 Monitoring Air Emissions

TJNAF complies with Commonwealth and Federal regulations regarding sources of potential air pollution. The Federal Clean Air Act (CAA) and its 1990 Amendments (CAAA) regulate the air emissions from DOE's processes and facilities. TJNAF has no processes that require air permitting. Emission estimates on the site's natural gas-fired boilers are derived from consumption and emission factors, and this information is provided to the DEQ upon request.

There have been no major changes in TJNAF's minimal level of air emissions since the 1995 review of non-radiological emission sources. Therefore, TJNAF, remains below any reporting thresholds. Compliance with all applicable clean air standards was maintained in 2006.

National Emission Standards for Hazardous Air Pollutants (NESHAPs)

NESHAPs govern air emissions that contain hazardous components, such as radionuclides and asbestos.

Radionuclide Emissions

The EPA administers the radionuclide program in Virginia. Radionuclide emissions generated during CEBAF and FEL testing and operations fall under NESHAPs requirements. (Refer to Section 3 for discussion of direct radiation, the primary form of radiation generated on-site.)

To address NESHAPs requirements, TJNAF uses sampling results and calculations to demonstrate that Lab operations remain below the EPA-defined threshold for permitting of 10 millirem per year (mrem/yr) potential effective dose equivalent to any member of the public. As airborne concentrations are below monitoring thresholds, routine monitoring of radioactive airborne emissions at the site boundary is not required; however, the Lab does make periodic confirmatory measurements to verify low emissions.

Under requirements of the CAA, TJNAF submits the annual NESHAPs emission report to the EPA. The estimated dose equivalent from airborne releases in conjunction with the Lab's accelerator operations during 2006 was 0.010 mrem. Refer to Section 3.2.1 for more information.

Asbestos Removal
The NESHAP standard requires that individuals conducting asbestos-related training and activities follow approved procedures, and employ specific work practices to prevent release of asbestos to the air. The Trailer City Complex, removed then demolished in early 2006, contained no asbestos materials.

2.2.2 Other Programs with Compliance Commitments

2.2.2.1 General Water Programs

General Permit for Small Municipal Separate Storm Sewer Systems (MS4s) - VAR040079
This permit authorizes operators of MS4s to discharge storm water to surface waters within Virginia. The permit's intent is to keep surface waters free of sediment and other pollutants. Under this permit, the Lab maintains a storm water management program, as noted in Chapter 6733 of the TJNAF ES&H Manual. The permit also requires that the Lab implement appropriate best management practices (BMPs) and set related measurable goals to address the control measures identified in the permit. One of the BMPs is to track by FY the number of incidents, such as spills, that could or did impact storm water. There were not any spill incidents that had the potential to affect storm water quality in 2006.

General Permit for Storm Water Discharges of Storm Water from Construction Activities –VPDES Permit No. VAR103277
The main requirement under this permit is that the Lab have a documented Storm Water Pollution Prevention Plan (SWPPP) that must be followed for all projects disturbing one or more acres of land. The permit authorizes TJNAF to discharge storm water from areas disturbed by such construction activities. Though no monitoring is required under this permit, strict erosion and control measure inspection and maintenance requirements are incorporated into subcontractor specifications. TJNAF's Facilities & Logistics Management Division oversees civil construction projects, ensuring that subcontractors adhere to this permit and other contract-specified standards.

Permit to Withdraw Groundwater - No. GW0047200
Pumping to maintain water table control will be necessary for the life of the facility, to prevent the partially buried experimental halls from taking on water and damaging equipment in the halls. A network of tile fields and drains collects local groundwater into a sump pit, from which it is pumped and discharged to the surface. The only parameter regulated under this permit is the quantity of water pumped. This authorization enables TJNAF to pump a maximum of 775,000 gallons monthly and 7,074,000 gallons annually.

The quantities of water pumped from these tile fields are reported to the DEQ. All withdrawal quantities, both monthly and annually, were well within permit limits. The affected groundwater is sampled for water quality parameters under VPDES Permit No. 0089320. There were no unusual issues regarding this discharge in 2006.

Spill Prevention, Control, and Countermeasure (SPCC) Plan
The TJNAF SPCC Plan is reviewed annually and last updated in 2004. This plan addresses all oil-containing storage tanks and equipment on-site. Oil inventory at TJNAF consists mainly of numerous oil-filled electrical transformers ranging in volume from 2 gallons to

about 4,800 gallons, and emergency generators (including one holding 5,000 gallons). The total volume of oil on-site is estimated to be about 40,000 gallons, with about 6,000 gallons of this total under the control of Dominion Virginia Power, the regional electric service provider. The Lab maintains a used oil collection area to assist in managing any resulting used oil. To ensure proper handling and response (in the event of a spill or release), all staff who work with oil receive SPCC Training.

Potential oil spill sources are located such that surface water discharge spillways and the sluice gates located at the site boundary can be effectively used to prevent any oil spills from leaving the site. Most DOE transformers utilize secondary containment, while the Dominion Virginia Power transformers have none. Like TJNAF, Dominion Virginia Power maintains a SPCC Plan that includes oil-containing items at the Lab.

There were no spills in 2006. Minor leaks were promptly addressed, and there was no adverse impact on public health or the environment as a result of the minor contained leaks.

Secondary Containment in Use

2.2.2.2 General Air Programs

National Ambient Air Quality Standards (NAAQS)

The EPA has established NAAQS for sulfur oxides, particulate matter, carbon monoxide, ozone, nitrogen dioxide, and lead. In 2006, the Hampton Roads area, which includes Newport News, Virginia, remained in attainment status for all NAAQS pollutants; the ozone nonattainment designation of prior years was revised to attainment in 2006.

No monitoring of air pollutant emissions is required at TJNAF. There are no applicable NAAQS emissions sources present on the site, although accelerator operations do result in the generation of small quantities of ozone. There are no environmental or public health effects from this generation; however, ozone is monitored as a worker health issue and is appropriately controlled.

Stratospheric Ozone-Depleting Substances (ODSs)
To support the CAAA and one of the objectives in Executive Order (EO) 13148, Greening the Government through Leadership in Environmental Management, TJNAF strives to minimize the use of ODSs by using safe, cost-effective, environmentally preferable alternatives. ODS-containing items used at TJNAF include refrigerants, degreasers, cleaners, and aerosol can propellants. The phase out of these substances will have a moderate impact on the site. To reduce ODSs and ODS-containing items on-site, TJNAF utilizes trained and licensed subcontractors and staff to perform all work involving ODS-containing refrigeration and air conditioning equipment. As well, TJNAF has one ODS recovery machine on-site. The one remaining chlorofluorocarbon (CFC)-based chiller on-site receives preventive and corrective maintenance by a qualified mechanical subcontractor to ensure optimal performance and minimal CFC losses.

TJNAF maintains four, 150-pound Halon fire extinguishers for use on delicate electronic equipment in the experimental halls. They release no ODSs unless used, and there has been no such use to date. They will require hydrostatic testing in 2008, and minor releases can be expected at that time.

The Director of Facilities & Logistics Management must approve all purchases of equipment containing ODSs.

2.2.2.3 Waste Programs

Waste Management
Waste streams at the Lab include both RCRA (Resource Conservation and Recovery Act of 1976) (hazardous and non-hazardous solid) and non-RCRA (low-level radioactive and medical) wastes. Site programs address applicable Federal requirements, which Virginia has adopted. The Lab endeavors to reduce its waste generation and has made progress in some areas. Lab staff encourages the reuse or recycling of previously used or discarded materials wherever possible. Waste generation and recycling quantities are tracked and reported annually to the DOE.

There have been no waste management activities associated with spills or cleanup actions under other Federal programs such as the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA). There were no such waste-related compliance issues in 2006.

Resource Conservation and Recovery Act (RCRA)
RCRA promotes the protection of health and the environment and the conservation of valuable material and energy resources. RCRA provides the EPA with the authority to regulate solid waste, from minimization and recovery to collection and disposal.

RCRA wastes include the Lab's hazardous and non-hazardous special waste streams and waste that is recycled or sent to a landfill. In June of 2006, the EPA conducted a multimedia compliance inspection, with DEQ assistance. Some RCRA issues were discussed but no violations were noted. One issue involved labeling of lab-pack containers; TJNAF addressed the concern immediately, and no other concerns were noted during the closing conference. However, soon after the compliance inspection, EPA posted on its Enforcement and

Compliance History Online (ECHO) website that the site was in violation of RCRA. EPA has since acknowledged that the posting was an error and has stated that the record would be removed; the removal of the posting had not yet been accomplished during 2006.

In FY 2006, 7.13 tons of routine RCRA hazardous wastes and approximately 195 tons of general refuse were reported to the DOE. An increase from the FY 2005 generation of RCRA waste resulted from one-time removal of lead debris from the site. The Lab has been a SQG of hazardous waste since its inception; however as a result of the lead cleanup, TJNAF voluntarily reported as a large-quantity generator for two months in 2006 (then returned to SQG status). RCRA hazardous and normal landfill wastes are managed for disposal by the appropriate staff in the ESH&Q Division and in the Facilities & Logistics Management Division, respectively.

The two largest volume hazardous wastes generated were a waste acid mixture used for niobium cavity processing and waste solvents from cleaning operations. TJNAF neither transports hazardous wastes nor operates any regulated treatment or disposal units. All wastes are disposed of through licensed waste handling transporters and facilities.

Improvements in hazardous waste generation rates have been recognized and documented with the use of performance measures. TJNAF has made notable progress in meeting hazardous waste minimization objectives, primarily through the use of the newest acid neutralization system. ESH&Q Division staff, working with those regularly using chemicals, continued to emphasize substitution, reduction, and reuse of hazardous materials in the workplace.

Other Wastes

Other wastes generated at the Lab (not covered under RCRA) include radioactive, medical, and recyclable wastes. Only a minimal amount of medical waste is generated at TJNAF, and its disposal is in accordance with the site program and all applicable regulations. Other non-hazardous wastes are disposed of in landfills, reused on-site, recycled, or used for other purposes offsite. The quantity recycled in FY 2006 was about 120 tons, which included about 37 tons of scrap metal. These "other wastes" are managed for disposal by the appropriate RadCon, Facilities & Logistics Management, and Occupational Health staff. There were no compliance issues in any of these programs in 2006.

Low-Level Radioactive Wastes (LLW)

The only radioactive waste the Lab generates is LLW; thus, there is no source of special nuclear materials. In 2006, 2.9 m^3 (cubic meters) of LLW was generated at TJNAF. To date, there has been no generation of mixed (a mixture of hazardous and radioactive) waste.

2.2.2.4 Emergency Planning & Community Right to Know Act (EPCRA)

Under EPCRA, which is aligned with the Superfund Amendments and Reauthorization Act (SARA), TJNAF is responsible for planning for, and being prepared to respond to chemical emergencies. As well, TJNAF is responsible for completing applicable reporting requirements, such as toxic chemical usage and environmental releases, if there are any. TJNAF files an annual SARA Tier II report with three emergency planning and response groups (EPRGs) - the EPA, the DEQ, and a local planning group. The items reported for 2006 were nitric, hydrofluoric, and sulfuric acids; bromine; argon; helium; nitrogen; lead;

propylene glycol; and hydraulic oil. The Lab has not used any chemicals that are either toxic or on the persistent, bioaccumulative, or toxic (PBT) list in quantities that exceed Toxic Release Inventory reporting thresholds. Under EPCRA, the Lab must also have a MSDS (Material Safety Data Sheet) available for every chemical on-site. TJNAF has had no releases to date that meet the CERCLA or SARA release reporting criteria.

2.2.2.5 National Environmental Policy Act (NEPA)

NEPA, as amended, outlines the Federal policy to restore and enhance the environment and to attain the widest range of beneficial use without degradation. NEPA-related actions are handled in conjunction with the DOE, which is committed to following both the DOE and EPA-related regulations. TJNAF assists the DOE by preparing documents and performing assessments of existing documentation.

NEPA requires that projects with potentially significant environmental impacts be evaluated and alternative actions explored. These evaluations are to be performed and reported as either an Environmental Assessment (EA) or an Environmental Impact Statement (EIS). Besides the EAs, TJNAF meets routine NEPA requirements by continuing to implement a program of reviewing construction activities for compliance. Activities in 2006 were addressed under the site's active DOE-approved Categorical Exclusion (CX) actions, EAs, and internal CX reviews. During 2006, an EA (DOE/EA-1534) was prepared to address the CEBAF 12 GeV Upgrade. The Finding of No Significant Impact (FONSI) for the EA was completed by the DOE in January 2007.

2.2.2.6 Compliance with Other Regulations and Federal Standards

Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA)

FIFRA applies to the storage and use of herbicides and pesticides. Use of these substances has environmental implications, especially where water quality is concerned. As such, the application of herbicides and pesticides is handled and permitted by subcontractors through a Commonwealth-administered certification program.

In order to minimize the chances of herbicides and pesticides washing into local storm water channels, TJNAF requires that there be no outdoor application of these compounds when rain is expected. To further minimize the chances of pollution, no industrial-strength herbicides or pesticides are stored or disposed of on TJNAF property. Only small amounts are mixed on site. The subcontractor is further responsible for handling any waste disposal through an authorized disposal facility. Small containers of household pesticides are stored on-site and applied per manufacturer's recommendations.

Applicable Executive Orders (EO)

There were numerous activities conducted throughout the Lab in 2006 that furthered efforts to be an environmental steward, especially in waste minimization and P2. Some actions were related to EO requirements, others were staff-initiated, and some a combination of the two.

Information on how the Lab addresses applicable EOs follows:

EO 11990 Protection of Wetlands

EO 11990 ensures that adverse impacts to wetlands from construction activities are avoided or responsibly mitigated. Evaluation of TJNAF activities involving potential wetlands is accomplished through the NEPA review process.

EO 11998 Floodplain Management
EO 11988 relates to the occupancy and modification of floodplains. There is localized flooding during significant rain events, but no part of the site is within the 100-year floodplain

EO 13101 Greening the Government through Waste Prevention, Recycling and Federal Acquisition
EO 13101 encourages agencies to implement Affirmative Procurement (AP) by promoting the purchase of products made with recycled materials. The purchase of these materials helps "close-the-loop" in the recycling process.

To comply with this EO, the DOE has set goals and performance standards, including a DOE complex-wide FY 2006 procurement target of 100% for purchasing recycled content EPA-listed products. The Lab has reached an internal goal of 100%, as its compliance level rose to 98%, with an adjusted compliance total of 100% for FY 2006.

EO 13123 Greening the Government through Efficient Energy Management
This initiative focuses on energy efficiency (E2) as a means of P2. The DOE seeks a 2005 energy use reduction of 20%, and a 2010 energy use reduction of 25% for industrial/lab category facilities from a 1999 baseline. For FY 2006, TJNAF documented a 47.1% energy use reduction in all reportable industrial/lab category buildings compared to the 1999 baseline year. The site's highly energy intensive production-related buildings and the CEBAF Center's Computer Center are considered to be exempt from reporting at this time.

EO 13148 Greening the Government through Leadership in Environmental Management
This EO identifies a number of actions for Federal Agencies to implement. These actions include developing an Environmental Management System (EMS), reducing the use of ODS and toxic chemicals, and reporting under EPCRA.

In 2006, TJNAF addressed EO 13148 and general P2 and E2 goals by: further implementing our EMS (see Section 2.1); working to reduce ODS use (see Section 2.2.2.2); minimizing chemical use, not only in day to day Lab operations but also in grounds maintenance; reusing and recycling various items, from chemicals to cardboard boxes (to the extent practical) (see Section 2.2.3); and disposing of wastes in the most environmentally practical and safe manner. TJNAF continues to make progress in meeting the requirements of this EO, as found throughout this report.

Dogwood Blossoms

2.2.3 Environmental Stewardship at TJNAF: Other Site Programs

Waste Minimization and Pollution Prevention (WMin/P2)
Waste minimization, in combination with other P2 strategies, is recognized as the most cost-effective form of environmental protection (EP). TJNAF's WMin/P2 Awareness Plan fosters the philosophy that waste prevention is superior to paying either for special disposal or for remediation. The goal of the program is to incorporate WMin/P2 into the decision-making process at every level throughout the organization. This is accomplished by having line managers, assisted by both line and ESH&Q Division staff members, ensure that staff are knowledgeable about the benefits of WMin/P2; consider the waste implications of a new or modified process during the planning stage; and are recognized when ways to enhance EP are brought to their manager's attention. These practices benefit the environment, protect employees and public health, reduce site waste disposal costs, and foster good community relations.

EP in Product and Service Life Cycles
A variety of products and materials are purchased or otherwise obtained for on-site use. When the materials have served their purpose, they are disposed of in accordance with TJNAF policy. As there are EH&S risks involved, TJNAF has programs and procedures in place that include EP and sustainability considerations.

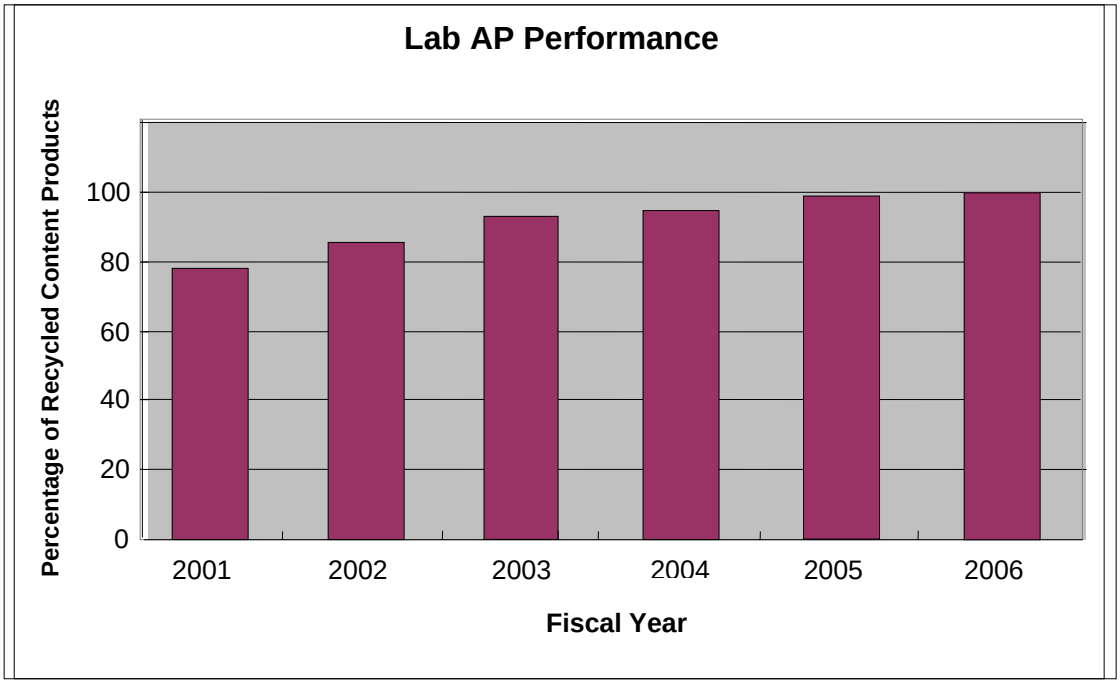
Environmentally Preferable Purchasing and Planning
TJNAF is committed to integrating environmentally preferable purchasing and sustainability considerations into the acquisition of products, services, and construction projects when feasible. This responsibility is founded on the Lab's commitment to P2 and sound environmental stewardship. Our efforts go beyond the AP requirements regarding EPA-designated products under EO 13101, and include the active avoidance of purchasing items that contain ozone-depleting substances.

TJNAF continues to make steady and consistent progress toward meeting the DOE AP goals and requirements and in implementing other environmentally preferable purchasing measures (refer to Section 2.2.2.6). Refer to Figure 2.2-1, which shows the Lab's consistent progress. The percentage

of products purchased with recycled content that meet EPA definitions are indicated. The numbers shown include those purchased that met 'exclusion' criteria (such as an unavailability of recycled content products or unsatisfactory pricing).

Procurement continues to increase employee awareness of EPA-designated products and provide ready access to these recycled content/remanufactured products. Office supply purchases made using Purchase Cards (PCards) have been restricted as a full line of AP items is available using the Lab's e-commerce system. Facilities & Logistics Management and other staff continue to explore opportunities to find users or vendors that will take or buy items that are no longer needed for Lab operations.

Figure 2.2- 1
Affirmative Procurement Performance



EP Considerations in Building and System Design and Construction Activities
Though the CEBAF accelerator complex is the site's primary energy user, energy management principles are applied throughout the Lab. Subcontractors and staff who are involved with the design of new buildings, or with changing and modifying existing buildings or utility systems, evaluate and implement energy and water conserving strategies where feasible. In 2006, TJNAF continued evaluating energy- and water-saving technologies for potential site application.

Environmentally Preferable Use
Besides selecting the environmentally preferred product or service for the desired activity, staff and users of TJNAF are responsible for following safe and environmentally sound use, storage, and waste management practices.

Standard requirements, such as ensuring that secondary containment is present and proper ventilation for the process is provided, help to minimize exposure to potential hazards. Lab staff and subcontractors have taken opportunities to minimize energy and water use.

Energy Management - With an increased emphasis on energy management, selected mechanical and electrical improvements have been made to building and process systems and equipment in order to improve their performance and reliability. The Lab has exceeded the prescribed energy goals. Facilities & Logistics Management, which is also responsible for new building construction, is also taking energy efficiency (E2) into account during the design process.

Water Conservation - TJNAF uses about 56 million gallons of water annually, with 79% directly related to process or facility heat rejection. Much of this water is evaporated in cooling towers for process cooling and air conditioning. With an increased emphasis on water conservation, water-using processes and site maintenance activities continue to receive extra attention. Available techniques are used to minimize water use, including a regular maintenance program. New projects that need water are reviewed to minimize water use. Existing water-using activities are, or will be, evaluated to reduce water usage as much as possible based on a life cycle cost. In addition to new water use reductions at the cryogenic plant, water reductions for landscaping were again implemented in 2006.

Environmentally Preferable Disposal

Today's rapidly changing technologies, products, and practices carry the risk of generating materials and wastes that, if improperly managed, could impair or threaten public health and the environment. In this regard, TJNAF encourages, and, where appropriate, requires the purchase and use of products and services whose waste products will have minimal impact on the environment and public health. Once the waste is generated, Lab staff members are responsible for ensuring proper segregation and disposal of waste items.

The range of options for disposition of materials includes recycling, neutralizing, scrapping, or providing spent chemicals or equipment to co-workers on-site or to other DOE facilities for reuse, or disposal in a local landfill. The Lab intends that all items be disposed of in the most environmentally acceptable manner, meeting all applicable regulatory and contractual requirements.

The Lab continues to implement waste reduction strategies and to educate and encourage staff on the proper disposition of recyclable materials. Lab staff, users and subcontractors continued to utilize Lab-wide office product recycling centers. Products collected at these local centers are: aluminum cans, small batteries, cardboard, CDs/diskettes, copier/fax/inkjet/laser cartridges, paper wastes, packing peanuts, telephone books, transparencies, Tyvek® envelopes, and plastic and glass bottles. The presence of local recycling centers has considerably increased staff recycling awareness and participation. In FY 2006, with scrap metal and automatic data processing equipment included in the total, TJNAF recycled about 120 tons of materials.

2.3 APPRAISALS, ASSESSMENTS, AND INSPECTIONS

The DOE Site Office, the DOE Oak Ridge Office, and various Commonwealth and local authorities provide external oversight of the TJNAF EP Program. Assurance that on-site processes do not adversely affect the environment is achieved through self-assessments, routine and invited inspections, and oversight by the DOE, DEQ, and the HRSD. TJNAF complies with all applicable laws, regulations, and permits. Actions of note undertaken in 2006 are described here.

DOE Review of TJNAF Self-Assessment

The DOE Site Office's Overlay Report, produced in conjunction with SURA/JSA's annual Lab-wide self-assessment, covers ES&H topics, and contains Site Office observations and reviews, DOE appraisal results, and other information. The Report provides an overall performance assessment for the year. For FY 2006, the Overlay Performance Evaluation Report yielded a rating of "A-", deemed by DOE as a notable accomplishment, in the ES&H category. The reduction from the previous "Outstanding" rating for environmental performance to a "B" was due to the one minor permit violation discussed earlier.

External Inspections

There were three external environmental inspections during 2006. HRSD staff conducted the first inspection of the year on February 6, 2006. The inspection covered several TJNAF buildings and a review of monthly and quarterly records. In June 2006, the EPA (with the assistance of the DEQ) conducted a multi-day, multimedia compliance inspection. While some waste management concerns were noted, all such concerns were resolved immediately, and the closeout conference cited no compliance issues. However, as discussed in Section 2.2.2.3, EPA has incorrectly posted on its publicly-available compliance data base that the facility was found to be in violation of RCRA. Efforts to correct this information continued through 2006.

The DEQ Division of Air Quality completed an inspection during September 2006, which confirmed that the Lab has no sources of air emissions that require permitting.

SECTION 3
ENVIRONMENTAL RADIOLOGICAL PROGRAM

Radiation and a variety of radioactive materials are produced as byproducts of research activities at TJNAF. The impacts of operating radiation-producing equipment and of working with and around radioactive materials have been taken into account in Lab procedures. Any potential impacts have been significantly reduced by applying standard control measures and by implementing ALARA, "as low as reasonably achievable", principles. The resultant potential effective dose equivalents to members of the public from various pathways, such as inhalation, ingestion, and skin absorption, are evaluated by the RadCon Department to demonstrate compliance with EPA and DOE regulatory limits.

TJNAF protects the environment and the public from exposure to radiation by implementing a number of both engineered and administrative controls. The radiological monitoring program is the primary means by which TJNAF accomplishes this objective. Exposure reduction support activities include using permanent and temporary shielding; using active and passive controls at activated water locations; and following proper protocols when handling radioactive materials and wastes.

The radiological monitoring program is designed to verify that radiation exposures, for on-site radiation workers, others at Jefferson Lab, and for members of the general public, are below applicable limits and are ALARA. The program also assures that Lab support activities and accelerator testing and operations, as described within the approved operational safety envelope, will result in minimal impacts to the environment and have minimal to no effect on public health.

3.1 RADIATION EXPOSURE PATHWAYS

Accelerator operations produce two broad pathways of potential radiation exposure to the public and environment: direct or *prompt* radiation, and *induced radioactivity* in equipment, air, and water. Direct radiation has a potential impact only within close proximity to a working accelerator on the site. In the category of induced radioactivity, the only authorized pathway to the environment for these materials is via regulated airborne and liquid effluents. TJNAF performed extensive environmental monitoring in 2006 to measure these forms of accelerator-produced radiation. Pathways to the general public are modeled and monitored when appropriate or as required by law. The decision to monitor a particular pathway is based on the:

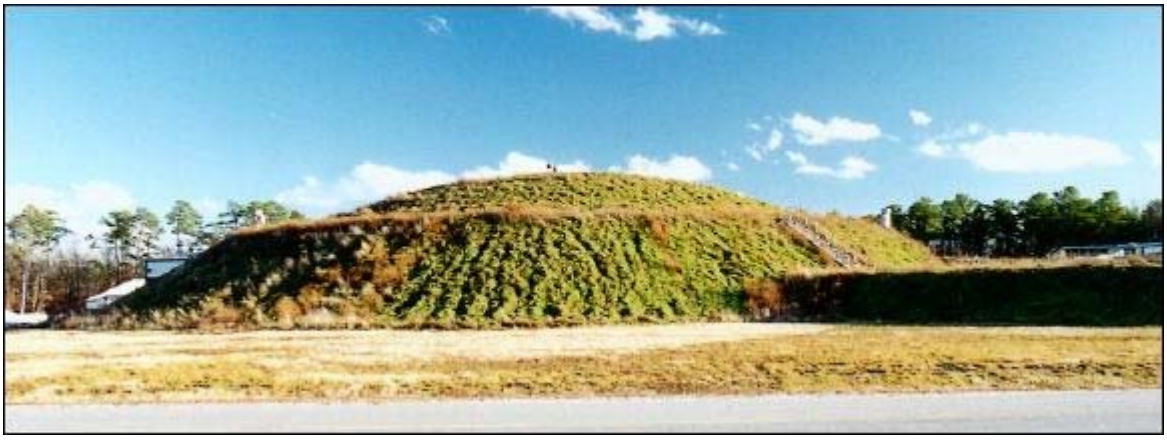
- type of operations
- radionuclides released
- potential hazard
- experience from previous monitoring results at TJNAF
- experience at other nuclear and high-energy physics laboratories

> *radioactivity* – a natural and spontaneous process by which the unstable atoms of an element emit or radiate excess energy from their nuclei and, thus, change (or decay) to atoms of a different element or to a lower energy state of the same element.

3.1.1 Direct Radiation

Direct or prompt radiation results from the interaction of the accelerator beam with matter. Accelerator operation (i.e., running an electron beam) produces significant levels of direct radiation within the accelerator enclosure. This radiation is produced within the beam enclosure and its production stops when an accelerator is turned off.

Almost all direct radiation is absorbed by extensive shielding, which is an integral part of accelerator design - any possible exposure to this radiation is at a maximum on-site and decreases with distance, so is insignificant at the site boundary. During 2006, TJNAF continued regular accelerator operations in support of physics experiments in the three experimental halls, as well as operation of the Free-Electron Laser facility. Accelerator operations and related activities were performed within an approved safety envelope, thereby maintaining potential exposures from prompt radiation well below design goals.



Earth Berm at Experimental Hall A

Accelerator enclosures, where direct radiation can be produced, are not accessible during accelerator operations. There are approximately 50 active, real-time radiation monitors and a series of associated passive integrating detectors deployed around the accelerator site. The primary purpose of most of these instruments is to shut off the accelerator in case of unusual radiation levels; a secondary benefit is measuring on-site radiation. The majority of the electronic detectors are connected to a central computer system that automatically records the radiation levels for subsequent examination. When appropriate, TJNAF employees, subcontractors, and visitors wear detection devices to monitor their on-site radiation exposure. Six dual-channel microprocessor-based instruments for monitoring gamma and neutron radiation levels collected direct radiation data (see Section 3.4 below) at the site boundary in 2006.

As stated above, the interaction of the accelerator beam with matter can cause the formation of radioactive materials through activation of matter. The beamlines, magnets, beamline-components, targets, detectors, other experimental area equipment, and the energy dissipating devices (beam dumps) used to contain the beam's energy may become activated. Cooling and ground waters, lubricants, and air in the beam enclosure may also become activated. These activated air, liquids, and particulates are possible sources of airborne and waterborne radioactivity. Though the direct

radiation stops when the accelerator is turned off, the activated equipment, water, and air continue to emit radiation. All material exposed to the beam is monitored for radioactivity prior to being removed from an accelerator enclosure.

Controls are in place to minimize exposure from both direct radiation and radiation from activated materials on Lab personnel, the environment, and the public.

3.1.2 Waterborne Radiation

TJNAF is situated in the central section of Newport News, Virginia, at an average elevation of about 35 feet above mean sea level. The site is in a Zone C area on the local flood maps, so is not considered to be within the 100-year floodplain. The Lab's accelerator site is located in the watershed of Brick Kiln Creek, which discharges to the Big Bethel Recreation Area. As water is a vital natural resource, contamination could present potential problems to the general population. Because of this, both the Federal government and the Commonwealth of Virginia regulate both groundwater and surface water.

Groundwater
An important element of the Lab's EMS, the TJNAF Groundwater Protection Management Program provides a strategy to minimize impacts to groundwater resources, and is used as a management tool to guide program implementation. The Program ensures compliance with Federal, Commonwealth, and local regulations, other identified standards, and effective resource management practices. The Lab's groundwater monitoring program serves to assess the effect of TJNAF activities on groundwater quantity and quality (see Section 3.2.2).

Soil activation is a potential source of groundwater contamination. Groundwater quality in the soil surrounding the accelerator complex is the Commonwealth's greatest concern with site operations. The monitoring of VPDES-permitted wells for specified groundwater quality parameters continued in 2006. Through a combination of engineered controls (e.g. shielding) designed into the CEBAF and FEL facilities, and adherence to operational limits, no significant amount of soil or groundwater activation is expected on-site, and no offsite effect is anticipated.

Surface Water
Surface water quality is maintained by discharging only permitted effluent from a cooling tower and unpolluted waters, such as rainwater, to the environment. To verify that there is no surface water activation, the surface water sampling program commenced at the time construction of the experimental halls was completed. The program continued in 2006, and included the quarterly sampling of the groundwater dewatering surface discharge under the VPDES groundwater quality permit discussed in Section 2.2.1.1. Additional samples were taken at a variety of locations on-site and analyzed to verify surface water quality.

All potentially activated water that is collected or discharged from accelerator enclosures is sampled to ensure it meets strict limits for on-site surface discharge. Any such water exceeding surface release criteria was collected and disposed of through the permitted process. described in Section 2.2.1.1.

The RadCon Department addresses any activated water spills, and if necessary, institutes mitigating measures to minimize potential impact on surface or groundwater.

Control measures involving radioactive water identified for the site include:

- Using proper procedures, such as secondary containment, around containers where activated water may be temporarily stored.
- Having activated water management procedures in place and using protocols, which provide for sampling and monitoring of potentially activated water (before release) from within all accelerator enclosures.

For information about other non-radiological surface water quality issues at TJNAF, refer to Section 2.2.

3.2 ENVIRONMENTAL RADIATION MONITORING

TJNAF uses environmental monitoring to assess local and offsite environmental conditions. The site environmental monitoring program verifies that any radiation exposures, and radioactive and non-radioactive releases, comply with applicable regulations and other requirements.

While radiation dose rates offsite (from direct and airborne radioactivity) are expected to be well below limits set for the general public, monitoring ensures that the established controls are effective. TJNAF operations have minimal radiological dose impact to the public and the environment. Adhering to Lab programs and using the input from outside advisory committees ensures that the Lab continues to function within regulatory and established administrative limits for direct radiation and airborne emissions. There have been no offsite releases of waterborne radioactivity (apart from the small quantities discharged under the Lab's HRSD permit).

The overall effects on the environment and the public from TJNAF's operations are summarized in Exhibit 3.2-1. There were no non-routine releases so all values shown result from routine operations. The net ambient external dose measured was 1.1 mrem (11 μSv (microSieverts)). This is well below the DOE standard of 100 mrem (1 mSv) for dose to members of the public from all pathways. Information about the air and water monitoring programs follows.

3.2.1 Air

Airborne radionuclide concentrations continue to be too low to directly measure at the site boundary. Annual calculations, using EPA-approved computer modeling codes, show that TJNAF operational emissions remain several orders of magnitude lower than the EPA 10 mrem/yr limit. TJNAF continued making measurements to verify the very low calculated release rate. (Refer to Exhibits 3.2-1 and 3.2-2) A report, documenting that the 2006 dose to the maximally exposed individual of the public was 0.010 mrem/yr (0.10 μSv/yr) due to airborne releases, was sent to the EPA in 2007. This dose is insignificant when compared to the applicable EPA regulatory limit of 10 mrem/yr (100 μSv/yr).

3.2.2 Water

Groundwater
Activation of groundwater, as a result of direct or secondary radiation, is possible in certain locations around the accelerator complex. Tightly controlled operational protocols and extensive shielding around the accelerator beam enclosures minimize groundwater activation. The monitoring conditions

in VPDES Permit No. VA0089320 serve as the basis for evaluating accelerator-produced radioactivity in groundwater. The data collected through the completion of facility construction in 1995 provide a groundwater quality baseline for comparisons during long-term facility operation. The background samples were analyzed for naturally occurring radionuclides, accelerator-produced radionuclides, and selected chemical parameters. The radionuclides analyzed in 2006 are those known to relate to operations associated with electron accelerators. They include H-3 (Tritium), Be-7, Na-22, Mn-54, and gross beta. Total manmade radioactivity was also analyzed. The general water quality parameters measured were pH, conductivity, TSS and TDS.

This VPDES groundwater quality permit specifies EPA-approved sampling and analysis protocols, which were the basis of groundwater monitoring in 2006. Fifteen wells were sampled at either quarterly, semi-annual, or annual intervals. The permitted wells included the "A", "B", and "C" Ring wells (labeled as to proximity to the CEBAF accelerator) and the upgradient well, as shown on Exhibit 3.2-3. Along with the A-ring wells, the groundwater dewatering effluent at the experimental halls was also monitored quarterly in 2006 and reported under this permit. The annual effective dose equivalent to an individual consuming water activated at this level is so negligible it cannot be measured.

The VPDES groundwater quality action and permit levels for radiological parameters are representative of normal background radionuclides, which are also generated through TJNAF activities. Note that if a permit action level should be reached at an A-Ring well, it would not result in a permit violation, but would trigger an internal investigation of potential causes.

The maximum radiological results obtained from monitoring the wells in the accelerator vicinity during 2006 are presented in the first part of Exhibit 3.2-4. The results from the other locations described in the permit are shown in the second half of the exhibit. All measurements were within permit levels. No accelerator-produced activity has been detected. All values represent natural background, and variations are normal.

Other Water Monitoring

The Cooling Water Tank (located in Building 92) and the floor drain sump (FDS) pit (located in Building 97) are considered one HRSD sampling point. The cooling water tank is used to collect activated water from various sources, including from the beam dump cooling water systems and from various discharges from accelerator apparatus and accelerator dehumidification condensate. The FDS pit contains various discharges including low-level activated dehumidification condensate from the hall air conditioning systems. Sampling and analysis for applicable radionuclides were performed and reviewed to ensure HRSD criteria were met prior to any discharge from either location to the sanitary system. The analytical results are recorded and monthly and quarterly concentration values are maintained and are provided to HRSD upon request. The total quantity of radioactivity released to HRSD in 2006 is presented in Exhibit 3.2-5. See Exhibit 3.2-6 for the monthly and composite quarterly activity concentrations (at the sampling point) for 2006. The concentrations varied based on the quantity of beam dump cooling water discharged during the reporting period.

In 2006, other water sampling and analysis for radioactivity were performed on a periodic basis on various discharges from the accelerator enclosure sumps. Any water identified as a potential concern was collected and discharged according to the terms of the HRSD permit.

Exhibit 3.2- 1
TJNAF Radiological Dose Reporting Table for 2006

Pathway	Dose to Maximally Exposed Individual mrem/ (mSv)	% of DOE Limit 100 mrem/yr	Estimated Population Dose person-rem / (person-Sv)	Population within 80 km
Air	0.01 (1.0E-04)	0.01	0.024 (2.4 E-04)	-
Water	0	0	N/A	-
Other Pathways	1.1 (1.1 E-02)	1.1	Unknown/ Unknowable	-
All Pathways	1.1 (1.1 E-02)	1.1		214,000 est.

Notes: 0.007 = 7 x 10-3 = 7 E-03
Values presented in Exhibits 3.2-1, 3.2-2, & 3.2-5 are presented in Scientific Notation (example, 2 E-05 is 0.00002)
mSv = MilliSievert

Exhibit 3.2- 2
TJNAF Radiological Atmospheric Releases for 2006

Radionuclide [half-life (timeframes)]	Ci (Bq) in CY 2006
Tritium [12.26 yr]	1.07 E-02 (4.0 E+08)
Be-7 [53 .6 days]	1.56 E-03 (5.8 E +07)
C-11 [20.3 m]	4.57 E-01 (1.7 E+10)
N-13 [9.96 m]	3.46 (1.3 E+11)
O-15 [123 sec]	1.84 (6.8 E+10)
Cl-38 [37.29 m]	1.94 E-02 (7.2 E+08)
Cl-39 [55.5 m]	2.36 E-01 (8.7 E+09)
Ar-41 [1.83 hr]	1.59 E-04 (5.9 E +06)

Notes: 1 pCi = 1 x 10 E-12 Ci = 0.037 Bequerel (Bq)
1 Ci = 3.7×10^{10}
m: minutes

Exhibit 3.2.2- 3
Monitoring Well Locations

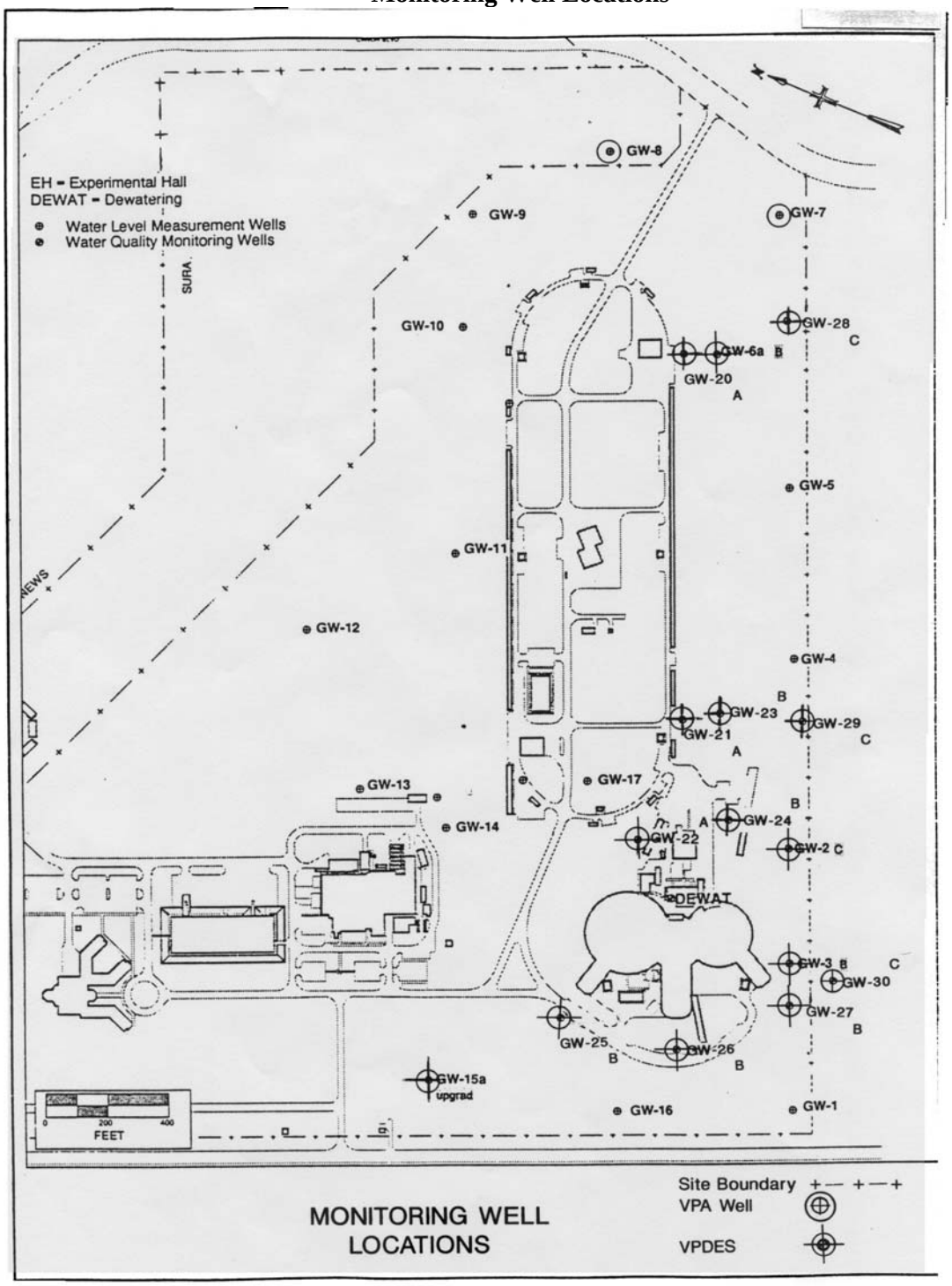


Exhibit 3.2- 4
Maximum Groundwater Measurements for Radionuclides Relevant to TJNAF Operations
January 2006 through December 2006

Radionuclides at Associated Wells Relevant to Accelerator Operations (in pCi/l unless noted otherwise)

Analyte	A-Ring	B-Ring	A and B Rings (Permit Level)	C-Ring	C-Ring (Permit Level)
Gross Beta	21.7	11.9	50	7.1	153
Manmade Radioactivity	< 0.151 mrem/yr	< 0.238 mrem/yr	1 mrem/yr	not applicable	–
Tritium	ND at < 906	ND at < 899	5000	ND at < 939	< 1000
Sodium-22	ND at < 14.4	ND at < 20.8	–	ND at < 9.0	< 61
Beryllium-7	ND at < 102	ND at < 170	–	ND at < 78.0	< 835
Manganese-54	ND at < 13.5	ND at < 17.1	–	ND at < 8.7	< 51

Radionuclides at Other Permit Locations (in pCi/l)

Analyte	Upgradient Well	Discharge 001
Gross Beta	4.0	19.4
Tritium	ND at < 892	ND at < 934
Sodium-22	ND at < 6.1	ND at < 21.2
Beryllium-7	ND at < 53.0	ND at < 160.0
Manganese-54	ND at < 6.0	ND at < 18.4

Notes: No accelerator-produced activity has been detected.
ND: Not detectable above permit-required sensitivity limits
Conversion: 1 pCi = 1 x 10^{-12} Ci = 0.037 Bq

Exhibit 3.2- 5
TJNAF Liquid Effluent Discharges of Radionuclides to HRSD for 2006

Radionuclide	Tritium (Permit Level 5 Ci) (Bq) H-3	Other Gamma-Emitting Radionuclides (Permit Level 1 Ci) (Bq) Be-7	Na-22	Mn-54
Ci (Bq) in CY 2006	9.43 E-1 (3.5 E+10)	1.39 E-03 (5.14 E+07)	4.02 E-05 (1.49 E+06)	3.83 E-06 (1.42 E+05)

Exhibit 3.2- 6
Analytical Results for Discharges to HRSD in 2006

Monthly Values

Reporting Period	Tritium Concentration (pCi/l)	Reporting Period	Tritium Concentration (pCi/l)
January	84,000	July	18,000
February	55,000	August	14,000
March	42,000	September	36,000
April	36,000	October	17,000
May	56,000	November	31,000
June	45,000	December	7,000

Quarterly Values

Reporting Period	Tritium Concentration (pCi/l)	Other Gamma-Emitting Radionuclides Concentration (pCi/l)		
		Be-7	**Na-22**	**Mn-54**
First Quarter	53,000	95	0.37	None detected
Second Quarter	46,000	14	1.1	0.12
Third Quarter	20,000	6.0	0.7	None detected
Fourth Quarter	16,000	120	4.1	0.53

Notes: These effluent concentrations are well below the 0.1 µCi/ml (1,000,000 pCi/l) permit limit.
Radionuclides are analyzed at EPA sensitivity levels or better.
Conversion: 1pCi = 1 x 10^{-12} Ci = 0.037 Bq

3.3 OTHER SUPPORT ACTIVITIES

Permanent shielding in the form of thick concrete walls and earthen berms protects the environment from exposure. Monitoring equipment continually measures and records radiation levels both inside and outside the facility, and where appropriate, automatically interrupts beam operation if unusual levels are detected.

Various accelerator-related water systems have the potential for becoming activated. All areas where activated water could be present have controls in place. Locations with a high potential for activation have secondary containment or other physical measures installed and administrative lockout/tagout controls. Other areas with less or even minimal potential for activation are monitored periodically to ensure levels are within expected values.

The RadCon Department establishes access-controlled areas to temporarily store radioactive materials, including those being stored for decay, and wastes. There is negligible impact to the environment and no impact on public health from the small quantity of these materials stored on-site.

3.4 ASSESSMENTS OF POTENTIAL DOSE TO THE PUBLIC AND TO BIOTA

The six active (real-time) radiation measurement devices noted in Section 3.1.1, installed along the accelerator site boundary, continued to be used to verify offsite dose to the public due to TJNAF operations. These electronic detectors - radiation boundary monitors (RBMs) - measure and log radiological information. In addition, passive integrating detectors are used for a number of site boundary measurements. All measured dose values were within statutory and administrative limits.

Exhibit 3.4-1 displays the radiation doses in mrem for 2006 at RBM-1 positioned near Hall A. RBM-1 is the detector that saw the largest dose from a combination of accelerator and experimental hall operations in 2006. A comparison with natural background radiation is made, which indicates the relatively low levels of TJNAF's contribution to the public dose. These background levels do not include contributions to dose from naturally-occurring radon, which typically doubles the natural radiation dose to the public.

TJNAF does not release any residual radioactive material, such as concrete or soil, so there are no resulting dose impacts to the public. The absorbed dose to any local aquatic animals, or terrestrial plants or animals, from TJNAF operations will not exceed the internationally recommended dose limits for terrestrial biota. There are no potential releases of a magnitude that could result in doses exceeding 0.1 rad/day to terrestrial animals, the lowest limit for any biota, so no dose limits will be exceeded.

TJNAF did not contribute significantly to the radiation dose received by the public through either airborne or waterborne pathways. The direct radiation exposure was again measurable in 2006, but was found to be about 11% of the TJNAF design goal of 10 mrem/year (which is one-tenth of the DOE limit).

Exhibit 3.4- 1
Radiation Boundary Monitor RBM-1 Results for 2006

Period	Neutron (mrem)	Gamma (mrem)	Total (mrem)
Jan-June	0.071 ± 0.018	0.018 ± 0.005	0.089 ± 0.02
July-Dec	0.822 ± 0.023	0.21 + 0.006	1.03 + 0.02
TOTAL	0.89 ± 0.03	0.23 ± 0.01	1.12 ± 0.03
Natural Background	~1.8	~110	~112

Notes:
Statistical errors are quoted at 1 sigma.
Systematic errors including calibration (not included) are approximately 30% for neutrons.
Gamma dose equivalent rates are estimated based on best known statistical correlation techniques.
RBM-1 received the highest dose.
Conversion: 1 mrem = 0.01 mSv

3.5 QUALITY ASSURANCE

Regular quality assurance (QA) efforts are being made to ensure that TJNAF's environmental monitoring program is performed in accordance with the principles of the TJNAF QA Program Manual.

3.5.1 QA in Sampling Procedures

The TJNAF QA Program includes qualification of the laboratories that provide analytical services, verification of certification to perform analytical work, and review of performance test results. Also included in this review is the adequacy of their internal quality control (QC) practices, recordkeeping, chain of custody, and the relevant portions of the QA program itself.

The RadCon Department and other program management are involved in the qualification process for environmentally sensitive services, including offsite analytical laboratories, and are responsible for auditing their own QA practices and implementing relevant QA procedures. The TJNAF QA function, now known as the QA/Continuous Improvement Department, performs independent assessments of all functional areas, including those for EP activities. The DOE oversight organizations, in their independent overview capacity, also perform periodic audits and surveillance of TJNAF. No QA concerns were noted for CY 2006 regarding sampling protocols or results.

Universal Laboratories, Inc. (Universal Labs) collected most VPDES and HRSD permit-related water samples. Eberline Services performed all radiological analyses on identified samples. Several field audits were performed and showed Universal Labs' collection procedures were satisfactory.

Other samples that involve radiochemicals, including some required by the HRSD permit, are collected by the RadCon Department and analyzed in the RadCon radiological analysis lab (Building 52).

3.5.2 QA in Analysis

Samples collected by external analytical laboratories are analyzed for radiological (and non-radiological) attributes using standard EPA-approved analytical procedures. Both external facilities and Jefferson Lab have a continuing program of analytical laboratory QC, participation in interlaboratory crosschecks, analysis of various blanks, and replicate sampling and analysis verifies data quality. RadCon, other ESH&Q Division staff, and other responsible Jefferson Lab personnel review all analytical data for the samples analyzed under their subcontracts. The analytical results are reviewed relative to the accompanying QA/QC results and compared with regulatory limits for acceptability. These reviews include inspection of chain-of-custodies, sample stewardship, sample handling and transport, and sampling protocols. When applicable to the analysis requested, analytical labs must be appropriately certified.

Ongoing precision and accuracy are monitored by analysis of the following with each batch of samples taken under Permit VA0089320: laboratory standards, duplicate determinations, matrix spikes, and matrix spike duplicates. These data are used to calculate the relative standard deviation on all applicable parameters. The quality of the data is then evaluated and compared to regulatory limits to determine acceptability. Satisfactory results from the vendors enable Jefferson Lab to validate compliance with the QA requirements in our permit.

3.5.3 External QA Performance Evaluations

TJNAF participated in two independent, external performance evaluation programs in 2006. One of them, the Mixed Analyte Performance Evaluation Program (MAPEP) is conducted by DOE's Radiological and Environmental Services Laboratory, and is available to all DOE subcontractors. This program tests the quality of environmental radiological and non-radiological measurements and provides DOE with complex-wide comparability of measurement performance. Performance evaluation samples are distributed semi-annually to participating labs. The results for 2006, including those results noted below can be found at http://www.inl.gov/resl/mapep/reports.html.

In 2006, Eberline Services and TJNAF's RadCon lab participated in the MAPEP. Performance results for all Eberline Services analyses were satisfactory for all relevant radionuclides in 2006. The RadCon lab's results were satisfactory with the following exceptions.

The TJNAF lab conducts analyses on three MAPEP sample matrices: Mixed Analyte Water (MAW), Mixed Analyte Soil (MAS), and Radiological Air Filter (RdF). Samples are analyzed by gamma spectroscopy. In addition, the MAW sample contains tritium. The RadCon lab conducted tritium analysis on the MAW sample, but was unable to eliminate chemical interferences in the matrix, and consequently reported an incorrect value for tritium. However, this type of sample is not normally encountered at the Lab, and routine counting procedures do not address preparation and analysis of such samples.. Therefore, TJNAF participates in a second performance evaluation program for tritiated water samples, through Environmental Resource Associates® (ERA). The samples provided through this program are a better match for the characteristics of water samples being counted in the RadCon lab. TJNAF results for tritium performance through the ERA program were satisfactory in 2006.

Additionally, in one MAW sample, the TJNAF result for Americium-241 (Am-241) was not satisfactory. This is not a nuclide of concern at TJNAF, but analysis for Am-241 can be used to indicate general performance for low-energy gamma emitters. Subsequent to this round of performance testing, TJNAF determined that the typical activity levels for this nuclide were below the level at which the RadCon lab could consistently report a statistically valid value using standard counting conditions. Therefore, TJNAF has discontinued conducting analysis for Am-241 in performance testing.

SECTION 4
DISTRIBUTION LIST

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Dr. Anthony W. Thomas, Associate Director, Chief Scientist
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Dr. Andrew M. Hutton, Associate Director, Accelerator Operations, Research & Development
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ACRONYMS and ABBREVIATIONS

These acronyms and abbreviations reflect the typical manner in which terms are used for this specific document and may not apply to all situations.

ALARA	As Low As Reasonably Achievable
Am	Americium
AP	Affirmative Procurement
ARC	Applied Research Center
BMP	Best Management Practice
Bq	Becquerel
CAA	Clean Air Act
CAAA	Clean Air Act Amendments
CASA	Center for Advanced Studies of Accelerators
CEBAF	Continuous Electron Beam Accelerator Facility
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFC	Chlorofluorocarbon
CHL	Central Helium Liquifier
Ci	Curie
CLAS	CEBAF Large Acceptance Spectrometer
CWA	Clean Water Act
CX	Categorical Exclusion
CY	Calendar Year
DEQ	(Virginia) Department of Environmental Quality
DOD	U.S. Department of Defense
DOE	U.S. Department of Energy
E2	Energy Efficiency
EA	Environmental Assessment
ESH	Extremely Hazardous Substance
ES&H	Environment, Safety, and Health
ESH&Q	Environmental, Safety, Health, and Quality
EIS	Environmental Impact Statement
E M S	Environmental Management System
EO	Executive Order of the President of the United States
EP	Environmental Protection
EPA	Environmental Protection Agency
EPCRA	Emergency Planning and Community Right-to-Know Act
EPRGs	Emergency Planning and Response Groups
ERA	Environmental Resources Associates
FDS	Floor Drain Sump
FEL	Free-Electron Laser
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
FONSI	Finding of No Significant Impact
FY	Fiscal Year
GeV	Billion (Giga-) electron Volts
HRSD	Hampton Roads Sanitation District
IR	Infrared
ISM	Integrated Safety Management
ISO	International Organization of Standardization
JSA	Jefferson Science Associates, LLC.
kW	Kilowatt
LQCD	Lattice Quantum Chromodynamics
LQG	Large Quantity Generator
LINAC	Linear Accelerator
LLW	Low Level Radioactive Waste
MAPEP	Mixed Analyte Performance Evaluation Program
MAS	Mixed Analyte Soil
MAW	Mixed Analyte Water
μSv	MicroSievert
m^3	Cubic Meters
mg/l	Milligrams per liter
mrem	Millirem
MS4	Municipal Separate Storm Sewer Systems
MSDS	Material Safety Data Sheet
mSv	MilliSievert
NAAQS	National Ambient Air Quality Standards
NASA	National Aeronautics and Space Administration
N D	Not detectable
NEPA	National Environmental Policy Act

NESHAPs	National Emission Standards for Hazardous Air Pollutants
ODS	Ozone-Depleting Substance
P2	Pollution Prevention
PBT	Persistent, Bioaccumulative, or Toxic
PCards	Purchase Cards
pCi/ l	Picocuries per liter
QA	Quality Assurance
QAP	Quality Assessment Program
QC	Quality Control
RadCon	Radiation Control (Department)
RBM	Radiation Boundary Monitor
RCRA	Resource Conservation and Recovery Act
RdF	Radiological Air Filter
R&D	Research and Development
RF	Radiofrequency
SA/QA	Self-Assessment / Quality Assurance
SARA	Superfund Amendments and Reauthorization Act
SER	Site Environmental Report
SNS	Spallation Neutron Source
SOP	Standard Operating Procedure

SPCC	Spill Prevention, Control, and Countermeasure
SQG	Small Quantity Generator
SRF	Superconducting Radiofrequency
SURA	Southeastern Universities Research Association
Sv	Sievert
SWP3	Storm Water Pollution Prevention Plan
TDS	Total Dissolved Solids
TIP	Target Implementation Plan
TJNAF	Thomas Jefferson National Accelerator Facility (Jefferson Lab)
TSS	Total Suspended Solids
Universal Labs	Universal Laboratories, Inc.
UV	Ultraviolet
VPDES	Virginia Pollutant Discharge Elimination System
WMin/P2	Waste Minimization/Pollution Prevention
WSS	Work Smart Standards

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